Course Title: **Radiological Control Technician**
Module Title: **Radiological Incidents and Emergencies**
Module Number: **2.13**

Objectives:

	2.13.01	Describe the general response and responsibilities of an RCT during any incident.
⇒	2.13.02	Identify any emergency equipment and facilities that are available, including the location and contents of emergency equipment kits.
⇒	2.13.03	Describe the RCT response to a Continuous Air Monitor (CAM) alarm.
⇒	2.13.04	Describe the RCT response to a personnel contamination monitor alarm.
⇒	2.13.05	Describe the RCT response to off scale or lost dosimetry.
⇒	2.13.06	Describe the RCT response to rapidly increasing, unanticipated radiation levels or an area radiation monitor alarm.
⇒	2.13.07	Describe the RCT response to a dry or liquid radioactive material spill.
⇒	2.13.08	Describe the RCT response to a fire in a radiological area or involving radioactive materials.
⇒	2.13.09	Describe the RCT response to other specific site incidents (as applicable).
⇒	2.13.10	Describe the response levels associated with radiological emergencies.
⇒	2.13.11	Describe site specific procedures for documenting radiological incidents.
⇒	2.13.12	Identify the structure of the emergency response organization at your site.
⇒	2.13.13	Identify the available offsite incident support groups and explain the assistance that each group can provide.
⇒	2.13.14	Discuss radiological incidents at the plant or other plants, including cause, prevention, and recommended incident response.

INTRODUCTION

Many people believe "it can't happen here" or "it won't happen to me" and do not take incident response planning seriously. But, incidents do occur, and experience has shown that the best response comes from workers who have prepared themselves with a plan for dealing with incidents. Each incident may be unique and no plan can be expected to give an exact solution to every problem, but a step-by-step approach for responding to a problem will help assure an appropriate response.

REFERENCES

1. 10 CFR 835 (1998), “Occupational Radiation Protection”
2. DOE Order 151.1, “Comprehensive Emergency Management Systems”
3. Site-specific emergency preparedness manuals

NOTE: This study guide should be developed using site specific information and regulatory documents. The following is a recommended format of material.

RADIOLOGICAL INCIDENTS AND EMERGENCIES

A radiological incident is an unplanned event involving radiation or radioactive materials (part of an emergency). The response taken to an incident is usually governed by normal procedures.

Emergencies are classified as either an Alert, Site Area Emergency, or General Emergency, in order of increasing severity, when events occur that represent a specific threat to workers and the public due to the release or potential release of significant quantities of radiological and non-radiological hazardous materials. Classification aids in the rapid communication of critical information and the initiation of appropriate time-urgent emergency response actions.

Causes of radiological incidents and emergencies could be one or more of several reasons:

- Ignorance
- Forgetfulness
- Oversight
- Unforeseen circumstances
- Communications failures
- Mechanical failures
- Human error
- Natural disasters

Having general guidance on response and a general plan of approach is good ALARA philosophy, because part of an appropriate response is the risk incurred by the responders and those involved as well as what is deemed to be an "acceptable" risk.

2.13.01 Describe the general response and responsibilities of an RCT during any incident.

GENERAL RESPONSE TO EMERGENCIES

Although Health Physics personnel respond to an emergency using basic guidelines, an area or site may have specific procedures which have priority over these guidelines. Health Physics personnel must be familiar with the emergency procedures applicable to each site and the types of equipment to which they are assigned. The basic guidelines can then be used in conjunction with the specific procedures. Even with general or specific

guidelines one's actions may change depending on the severity of an incident or whether one is a first responder, one of many responders, or a backup person.

The basic emergency response guidelines are:

- Define and assess the problem. Typically, personnel at the scene are a good source of information, however remote instrumentation and other resources should not be overlooked.

- Attempt to stop the cause of the emergency. No undue risks should be taken. One must always be aware that careless action may cause them to become part of the problem.

- Notify facility management and safety personnel. Minor incidents that can be handled by a single responding person may only require a telephone call when the opportunity presents itself. If more than one person is needed for an appropriate response, activation of a site emergency response network (such as dialing "911") is the manner in which notification should be given.

- Warn personnel in the area of the emergency. This keeps unnecessary personnel away from the event site, minimizing their exposure and risk.

- Isolate the area. Install barriers as quickly as possible to establish an exclusion area. The exclusion area may be very large initially. In determining the size of the exclusion area, internal and external exposure rates, potential for criticality, possible spread of radioactive contamination or other hazardous material, weather conditions, non-radiological hazards, and security (site security may assist in establishing boundaries). Outside the exclusion area normal operations may continue. Enlist whatever resources and personnel that are available to accomplish isolation and be prepared to help others in this endeavor even if there is no radiological risk.

- Minimize personnel exposure. During the initial response, remember to use ALARA concepts, as practical. Plan supplementary operations as necessary to assure personnel exposure is minimized. All planned exposures above the occupational limits (5 rem) is voluntary. The following are guidelines for control of emergency exposures:

    - Up to 10 rem for protecting major property and where lower dose limit is not practicable.

    - Up to 25 rem for lifesaving or protection of large populations where lower dose limit is not practicable.

    - Above 25 rem for lifesaving or protection of large populations. Only on a voluntary basis to personnel fully aware of the risks involved.

- Secure ventilation. Close entrances, windows, and the supply ventilation systems as necessary. Remember that most facilities are designed for proper ventilation and frequently one merely has to ensure that the design condition are being met such as closing doors, windows, and other openings that should not be open. One should only alter designed ventilation if it is obvious that ventilation and improper air flow patterns are contributing to the incident and impeding bringing it under control. Even with the conclusion to change ventilation, one should consult with facility management to determine the impact of changing ventilation on other activities that may be affected.

- Perform surveys. Health Physics personnel are trained to perform emergency surveys. The types of surveys will vary with the nature of the emergency. Good quality surveys take time. Do not short cut or speed up surveys unless a real need such as a medical need exists.

- Initiate the recovery. This includes clean-up operations, decontamination and moving the exclusion area barricade inward.

The RCT is the Health Physics person on site that has the experience, instruments, and the responsibility for radiation safety and other personnel will seek them out for answers. Be prepared to respond with answers, directives, and/or suggestions. Don't assume others will automatically know what to do. Debriefings for lessons learned typically obtain good information from the initial responders to incidents.

2.13.02	*Identify any emergency equipment and facilities that are available, including the location and contents of emergency equipment kits.*

FACILITIES AND EQUIPMENT

(Insert site specific information here.)

RCT's should always know the resources and equipment available to them in the area where they are working. These resources include the physical location, people, equipment, and communications.

Facilities

RCTs should have a thorough knowledge and understanding of processes and hazards of their assigned facility. This should include a knowledge of the *Site Emergency Response Plan*. These plans usually contain information concerning evacuation routes, staging areas, handling of contaminated personnel, and information concerning off-site support organizations.

Equipment

Typically, facilities maintain "emergency kits/cabinets" which contain supplies used in responding to emergencies. These kits/cabinets usually contain smears, gloves, bags, supplies for posting, dosimetry, respiratory equipment, and a copy of facility emergency procedures.

2.13.03 Describe the RCT response to a Continuous Air Monitor (CAM) alarm.

RESPONSE TO A CONTINUOUS AIR MONITOR (CAM) ALARM

Airborne radioactivity may be caused by a breach in a system, or resuspension of particulate radioactivity due to work evolutions such a welding, grinding, or other heavy work. Indications that an airborne contamination event is occurring include CAM alarms, air samples exceeding limits, and increasing radiation levels.

Initial Response

- Stop operations that may be causing airborne radioactivity
- Warn others to evacuate
- Secure unfiltered ventilation
- Contact line or facility management for support

Supplementary Actions (re-entry)

- Upon re-entry, don respiratory equipment and protective clothing based on conditions of the event
- Evaluate the affected area by taking an air sample, measuring radiation levels, and checking for CAM malfunction
- Obtain additional air samples as necessary to determine boundaries and maintain access control
- Identify isotope(s) to help determine problem source and protective measures
- Consider additional ventilation to minimize personnel exposure and reduce the need for respiratory equipment (HEPA)
- Measure and control surface contamination to minimize the spread of contamination

- Survey exhaust systems, ventilation filters, and ducts. Have decontamination performed as necessary to minimize contamination spread
- Evaluate the potential for internal exposure and contact facility dosimetrist for proper internal dosimetry protocol
- Personnel should be interviewed for information on any off-normal event which could have caused the alarm
- Take air samples, once operations resume, to verify that the cause of airborne activity has been corrected

(Insert site specific information here.)

2.13.04 Describe the RCT response to a personnel contamination monitor alarm.

RESPONSE TO PERSONNEL CONTAMINATION MONITOR ALARM

Initial Response

- Instruct affected worker to remain in area (standfast).
- Report to the scene with at least portable instruments for direct surveys and smear media.
- Perform whole body surveys (frisk) for the appropriate type of radiation (alpha and/or beta-gamma).
- Take actions to minimize cross-contamination, such as covering or placing a glove over a contaminated hand.

Supplemental Actions

- Survey affected area to characterize the extent of contamination.
- Suspect an up-take if contamination is verified and survey facial area for contamination, taking nasal smears or nose blows. If positive, contact RCT supervision and refer to your facility specific procedures.
- If contaminated, follow-up actions include saving any radioactive material pertaining to the contamination event, as this may help characterize the event at a later time.
- Refer to facility specific procedures if contamination persists.
- Document all surveys and estimate skin dose on proper forms. Do not unduly delay any decontamination efforts by taking too long in documenting

  contamination for skin dose estimates. Remember that dose is being incurred all the time that the skin is contaminated. Think ALARA especially in the case of high energy beta emitters.
- Report all confirmed skin contaminations to RCT supervision and refer to your facility specific procedures if transporting to a medical facility.
- Gather appropriate information for follow-up surveys.

Follow-up actions

Shall be in accordance with the site procedure. These typically include:

- Removal of contaminated clothing or decontamination of minor skin contamination. Decontaminate skin using mild non-abrasive soap and tepid water or decon toweletts. Continue decon as long as significant reduction in activity is occurring after each decon. Do not irritate the skin.

- Verification that personnel monitoring equipment is working properly. Equipment should not be returned to service until all problems are resolved. Alarms can be caused by a variety of equipment failures or by "nuisance" non-work related situations such as environmental radon resulting from local conditions.

(Insert site specific information here.)

2.13.05	*Describe the RCT response to off scale or lost dosimetry.*

RESPONSE TO OFF-SCALE OR LOST DOSIMETRY

Off-scale Self Reading Personal Dosimeter

- Assure that the worker is placed in as safe an area as possible (low dose area) and that the work has been left in a safe condition where possible.

- Alert others working in the area.

- Evaluate the situation. All dose indicated by the dosimeter is assumed to have been received by the individual until it can be clearly demonstrated otherwise.

- Gather data for dose estimate. Data typically includes work area dose rates, work activities, worker position, co-worker dose readings, and travel path conditions. For High exposures, the official permanent dosimetry (TLD or film badge) should be retrieved for processing.

Lost Dosimetry

For lost dosimetry, typical actions include:

- Individual(s) must leave the area if dosimetry is required.

- Contact RCT supervision for reissue of dosimetry.

Supplemental Actions

- Notify workers supervision
- Restrict additional entries until a dose assessment can be completed
- Consider suspending further work on the RWP until issues are resolved

(Insert site specific information here.)

2.13.06	*Describe the RCT response to rapidly increasing, unanticipated radiation levels or an area radiation monitor alarm.*

RESPONSE TO RAPIDLY INCREASING, UNANTICIPATED RADIATION LEVELS OR AN AREA RADIATION MONITOR ALARM

Initial Response

- Evacuate personnel as quickly as possible to a safe area (low dose area).
- Measure radiation levels in affected area.
- Notify line/facility management. Whether or not to activate a site emergency response program (such as dialing 911) is determined by the nature of the incident. Activation usually automatically fulfills this requirement. When a situation is confusing, not fully understood, or may not be controllable; over reacting is better than under reacting.
- Evaluate the situation. The best contact is people at the scene.
- Verify postings and boundaries are adequate.

Supplemental Actions

- Verify personnel staging area dose rates are acceptable and check individual exposures. Notify RCT supervision of results.
- Re-occupy area upon approval of line/facility management.
- Document all surveys using appropriate forms.

(Insert site specific information here.)

2.13.07 Describe the RCT response to a dry or liquid radioactive material spill.

RESPONSE TO DRY OR LIQUID RADIOACTIVE SPILL OF KNOWN MATERIAL AND ORIGIN REQUIRING SWIMS

(Insert site specific information here.)

- **STOP** the spill. Take appropriate precautions that are dependent on the situation. All spills are different. Correct the situation immediately if possible without taking undue risks.

- **WARN** other personnel. Let people around know what is going on. If the situation warrants, evacuate the area. Notify your supervisor, facility management, and emergency response network if appropriate. As before, whether or not to activate a site emergency response program (such as dialing 911) is determined by the nature of the incident. Activation usually automatically fulfills this requirement. When a situation is confusing, not fully understood, or may not be controllable; over reacting is better than under reacting.

- **ISOLATE** the area. Establish boundaries and post the area around the spill area for exposure and contamination control.

- **MINIMIZE** exposure to yourself as well as others. Practice ALARA principles and use all protective gear available.

- **SECURE** ventilation by controlling HVAC (heating, ventilation, air conditioning). Unless one is certain that ventilation is contributing to the incident, this may involve no more than just ensuring that conditions are correct for normal designed ventilation.

- **FOLLOW THROUGH** as necessary by starting and collecting air samples as may be indicated, surveying for contamination, and decontaminating. The cleanup of major spills may very likely involve many people and require Radiation Work Permits and ALARA reviews of activities. Do not try to clean up a major spill by yourself, just keep it contained and isolated until the entire clean up operation is formulated. Complete all documentation of surveys and logs.

If you are unsure if you can contain the spill, or if you do not know the nature of the spill, use the "WIN" process:

- **W**arn others

- **I**solate the area, keep personnel out

- **N**otify authorities

2.13.08	*Describe the RCT response to a fire in a radiological area or involving radioactive materials.*

RESPONSE TO A FIRE IN A RADIOLOGICAL AREA OR INVOLVING RADIOACTIVE MATERIALS

(Insert site specific information here.)

Typically Radiological Control will supply support to the Fire Department and will be represented at the Command Post.

2.13.09	*Describe the RCT response to other specific site incidents (as applicable).*

RESPONSE TO OTHER FACILITY SPECIFIC INCIDENTS

(Insert site specific information here.)

2.13.10	*Describe the response levels associated with radiological emergencies.*

EMERGENCY RESPONSE LEVELS

(Insert site specific information here.)

ALERT

An Alert shall be declared when events are predicted, are in progress, or have occurred that result in actual or potential substantial degradation in:

- Level of control over hazardous materials.
- Safety or security of a nuclear weapon, component, or test device that would not pose an immediate threat to workers or the public.
- Safety or security of a facility or process that could, with further degradation, produce a Site Area Emergency or General Emergency.

Site Area Emergency

A Site Area Emergency shall be declared when events are predicted, in progress, or have occurred that result in actual or potential situations that could include one or more of the following:

- Major failure of functions necessary for the protection of workers or the public.
- Threat to the integrity of a nuclear weapon, component, or test device that may adversely impact the health safety of workers in the immediate area, but not the public.
- Major degradation in level of safety or security of a facility or process that could, with further degradation, produce a General Emergency.

General Emergency

A General Emergency shall be declared when events are predicted, in progress, or have occurred that result in actual or likely situations that could result in one or more of the following:

- Catastrophic reduction of facility safety or security systems with potential for the release of large quantities of hazardous materials to the environment.
- Catastrophic failures in safety or security systems threatening the integrity of a nuclear weapon, component, or test device that may adversely impact the health and safety of workers and the public.

2.13.11	*Describe site specific procedures for documenting radiological incidents.*

DOCUMENTATION OF RADIOLOGICAL INCIDENTS AND EVENT CATEGORIZATIONS

(Insert site specific information here.)

2.13.12	*Identify the structure of the emergency response organization at your site.*

EMERGENCY RESPONSE ORGANIZATION

(Insert site specific information here.)

2.13.13	*Identify the available offsite incident support groups and explain the assistance that each group can provide.*

OFFSITE SUPPORT GROUPS

(Insert site specific information here.)

2.13.14	*Discuss radiological incidents at the plant or other plants, including cause, prevention, and recommended incident response.*

SITE SPECIFIC LESSONS LEARNED

(Insert site specific information here.)

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